



Hydration Technologies, Inc. – HydroWell Expedition

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Device Information

The Hydration Technologies, Inc., (HTI) HydroWell Expedition is a portable passive water treatment device utilizing an osmotic membrane for pathogen reduction. The device consists of a vinyl hydration pack bladder with enclosed osmotic membrane cartridge, ten 4-ounce nutrient charge syrup containers, 1 bottle Potable Aqua[™] iodine tablets (50 count), 1 bottle Campden Tablets (10 count, 100-mg sodium metabisulfite, 150 mg dextrose), 1 bottle test dye tablets (10 count), 2 bottles preservative solution (10 ml 14% sodium metabisulfite in water), collapsible cup, and hand pump bulb. The device requires the user to supply a hydration pack backpack capable of holding a 100 ounce bladder. The membrane cartridge utilizes the same semi-permeable membrane as other HTI products (Hydropack, X Pack), in a spiral wound configuration for greater surface area and increased production rate. According to the manufacturer, the membrane, although unlike conventional porous membranes, is equivalent to having a pore size of 0.0005 μm . This device uses no pumping to process the water, but rather uses osmotic potential across the membrane as a driving force. The raw water bag and nutrient charge bag are connected to the membrane cartridge. Through suction on the bite tube, the user pulls nutrient charge into the membrane cartridge which pulls the water across the membrane by creating an osmotic potential. To reduce this potential and equilibrate the solute concentration across the membrane, water is drawn from the less concentrated to the more concentrated side of the membrane until equilibrium is reached. The finished product is a sports drink similar to Gatorade[®]. Water production rate is proportional to solute gradient. The following nutrition information (Table 1) was approximated based on values from the HTI Expedition syrup containers, assuming a 3.6% finished product sugar concentration. This information is based per 1 L drink produced.

[™] Potable Aqua is a trademark of Wisconsin Pharmacal Company, Jackson, WI.

[®] Gatorade is a registered trademark of the Quaker Oats Co., Chicago, IL. Use of trademarked products does not imply endorsement by the U.S. Army, but is intended only in identification of a specific product.

Table 1. HydroWell Expedition Nutrient Charge Nutritional Information.

Parameter	Value/L Product
Calories	147
Total Fat	0 g
Sodium	20 g
Potassium	83 g
Sugars	36 g
Protein	0 g

Ingredients: fructose, water, citric acid, lime extract, sweetness enhancer, potassium citrate, sodium citrate, sodium benzoate, potassium sorbate.

Note: According to the manufacturer, the nutrient charge is undergoing reformulation.

Effectiveness Against Microbial Pathogens

Manufacturer in-house data showed virus reduction in excess of 4-log (reference 1). Results from an independent laboratory for a similar device (HTI, Inc., X Pack) show bacteria reduction in excess of 6-log (reference 2). No results were received that tested this device against the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3). Expert opinion states that this technology should be capable of meeting the log reduction requirements shown below when tested against the USEPA Standard for the manufacturer rated capacity of the device. The removal mechanism of osmotic membranes is complex but can be considered to be based on size exclusion utilizing very small pores that reject even dissolved contaminants. Based on the absence of independent results challenged against reference 3, this device is assigned a rating of one √ for the reduction of each pathogen ([click here](#) for rating explanation), indicating that expert opinion expects this device to meet the requirements of reference 3 (Table 2).

Table 2. Expected Performance Against Microbial Pathogens.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Primary Pathogen Reduction Mechanism
Bacteria	> 6-log	√	size exclusion
Viruses	> 4-log	√	size exclusion
<i>Giardia</i> cysts	> 3-log	√	size exclusion
<i>Cryptosporidium</i> oocysts	> 3-log	√	size exclusion



Production Rate and Capacity

Production rate and capacity of this device is dependent upon solute gradient across the membrane and temperature. Manufacturer stated production rate is 0.5 L/hr at 68° F (0.008 L/min). This device is demand driven. The user draws nutrient syrup into the membrane cartridge by creating suction in the drink tube. The production capacity is 12 L per day with a useful life of 30 days for a total production of about 360 L. Nutrient charges supplied with the device provide for about 30 L of drink. Unlike porous pressure driven filter devices, turbidity does not affect the production capacity or rate.

Cleaning, Replacement, and End of Life Indicator

The HydroWell Expedition is designed for 30 days of use with flushing every 7 days. Cleaning can be accomplished with or without access to potable water. With access to potable water, the user should empty both bags, fill and rinse with potable water, then empty both bags. Refill the product bag with potable water, add one bottle of preservative sodium metabisulfite solution, close and shake. Then, remove the bite valve and attach the hand pump. Squeeze the bulb to pump the solution through the device and out of the drink tube. Open the product bag port to relieve suction then close. Close all ports, reattach the bite valve then the device can be stored for up to 7 days. Prior to next use, add water to both bags, then pump all water out using the hand pump as explained above. If potable water is not available for cleaning, empty the dirty water bag, but leave about 2 cups of drink in the product bag. Add the preservative solution and pump out as explained above. The device can now be stored for up to 4 days. Prior to next use, fill the dirty water side with water, then pump out of the drink tube as explained above. The device can now be used to produce drink. This device is supplied with indicator dye to allow the user to determine visually if the membrane has been compromised. Due to user subjectivity, this is not considered a real time indicator of process failure. This device is purchased with 10 nutrient charges, capable of producing drink continuously for about 2 days. Additional nutrient charges can be purchased for water production of up to 30 days. At the end of 30 days from first use the device should be discarded regardless of volume of drink produced.

Weight and Size

The dry weight of the device is about 2800 grams.
Dimensions are (H x W x L) 8 cm x 16 cm x 40 cm.

Cost

HydroWell Expedition (nutrient charges for 30 L)	\$129.00
Resupply Kit (nutrient charges for 30 L)	\$29.00



Device Evaluation

No laboratory data was received for the HTI HydroWell Expedition challenging the device against the standards in reference 3. Since the device utilizes the same membrane, but in a different configuration, as the HTI X Pack, the results showing > 6-log reduction of bacteria for that device apply to the HydroWell Expedition. Based on the characteristics of osmotic membranes, reduction of viruses (> 4-log) and cysts (> 3-log) should be obtainable (reference 4). This device, although expected to meet the required pathogen reductions based on membrane exclusion alone, requires detailed chemical addition steps to limit bacterial growth on the membrane and promote adequate production rate. Prior to each bladder filling, the user must add 2 tablets of Potable Aqua™ iodine tablets and one test dye tablet to the dirty water bag, then one tablet of Campden sodium metabisulfite and one nutrient syrup bottle to the product bag. This device is demand driven. As the user pulls nutrient charge into the membrane cartridge, osmotic potential pulls water through the membrane. Since this device is demand driven, creating more suction will make the product drink more concentrated by reducing the time for water to pass through the membrane. Therefore, creating the 4% sugar solution recommended by the manufacturer is subject to the user's interpretation, affecting the production capacity of each nutrient charge. Additionally, users may be inclined to drink more concentrated solution rather than wait for proper solution concentration to be produced. Because nutrient charge is necessary to create the osmotic potential, the liquid produced is not water, but a drink similar to commercial sports drinks. The device is designed to be used for 30 days with cleaning every 3 - 7 days for a total capacity of 180 L. Cleaning is a somewhat complicated procedure that can be accomplished with or without access to potable water, however the procedure differs slightly as explained above. Since highly concentrated sugar solution is used to produce drink, bacterial growth is possible inside the bags, and therefore, cleaning is critical to prevent contamination. Care must be taken during storage and transport not to puncture or excessively abuse the bag by folding or creasing. Small defects in the membrane may allow pathogens across the membrane and be consumed without notice. This device is supplied with indicator dye to allow the user to determine visually if the membrane has been compromised. If the user detects a brown tint to the product drink then the device and product should be discarded without consumption. Since the user's ability to detect slight color change in the bite tube is uncertain, this is a questionable technique for determining device failure. Due to changing product components, instructions, product specifications, and price may vary between manufacturer website and product received. This device requires the addition of sodium metabisulfite. The bottle states that the user should not ingest this chemical, yet it is added directly to the product drink as well as used during cleaning. Persons allergic to sulfites should consult a physician prior to consumption. The manufacturer states a storage life of 3 years when kept below 90° F.



Advantages

- Technology is capable of reducing microbial pathogens in accordance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3).
- Osmotic membrane capable of rejecting microbial pathogens and most all other environmental contaminants.
- Unaffected by raw water turbidity.
- Incorporated into hydration pack, allowing hands free operation.

Disadvantages

- No test results showing compliance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3).
- Slow production rate.
- Drink sugar concentration subject to user operation enabling consumption of highly concentrated drink and reduced capacity.
- No real-time indicator of process failure.
- Chemical addition required.
- Complicated cleaning procedures.
- Does not produce water; product is similar to a sports drink.

References

1. Manufacturer in-house laboratory test results showing > 4-log reduction of virus, 2003. Provided by HTI.
2. Independent laboratory results of tests showing > 6-log reduction of bacteria. 2001. Provided by HTI.
3. USEPA, 1989. Guide Standard and Protocol for Testing Microbiological Water Purifiers. *Federal Register*. 54:34067.
4. U.S. Army Center for Health Promotion and Preventive Medicine, 2005. *Technical Information Paper; Filtration in the Use of Individual Water Purification Devices*, Aberdeen Proving Ground, MD.

